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BDELLOID ROTIFERA OF SOUTH AFRICA.

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(WITH PLATES I TO III.)

THE material for this paper was placed at my disposal through the kindness of the Director and Curators of the Transvaal Museum in Pretoria, Dr. Gunning and Messrs. J. Hewitt and T. Jenkins. Dry mosses from various parts of South Africa were sent to me from time to time during the year 1910. These I moistened and examined for Rotifera and other organisms. Some of the mosses were very productive, notably one sample from Pretoria; others yielded almost nothing.

The Bdelloida mentioned in this paper were obtained from four localities—Pretoria; Woodbush, in the North Transvaal; Pondoland, in the east, and Knysna, in the south of Cape Colony.

Previous knowledge of South African Bdelloida.—Very little has been written about the Bdelloida of South Africa. Ehrenberg in 1854 recorded two species for Cape Colony—*C. rediviva* and *C. hexaodon* (**12**)*. Thorpe in 1893 recorded *P. citrina* for the Cape of Good Hope (**36**). Kirkman in 1901 gave a list of seven species, but he was not confident about four of them (**16**). Rousselet in 1906 (**31**) summed up all that was known about South African Bdelloids, and included a list compiled by Mr. W. Milne, of Uitenhage, Cape Colony. His list numbers thirteen Bdelloids, but he omits the two species mentioned by Ehrenberg.

Mr. Milne has been working for some years at the Bdelloida of South Africa, but he has not to my knowledge published anything about them, except the list included in Mr. Rousselet's paper. He has found many species, and among them some very aberrant forms. He has been good enough to send me some moss, and among it I have found several of his peculiar species. We await the publication of his results expectantly.

* The figures in heavy type, enclosed in brackets, refer to the Bibliography at the end.

The Bdelloida of Central Africa are better known, and there are a number of early records for North Africa. At the end of this paper I propose to give a résumé of all that is known about African Bdelloids, and to compare the Bdelloid Fauna of South Africa with that of other parts.

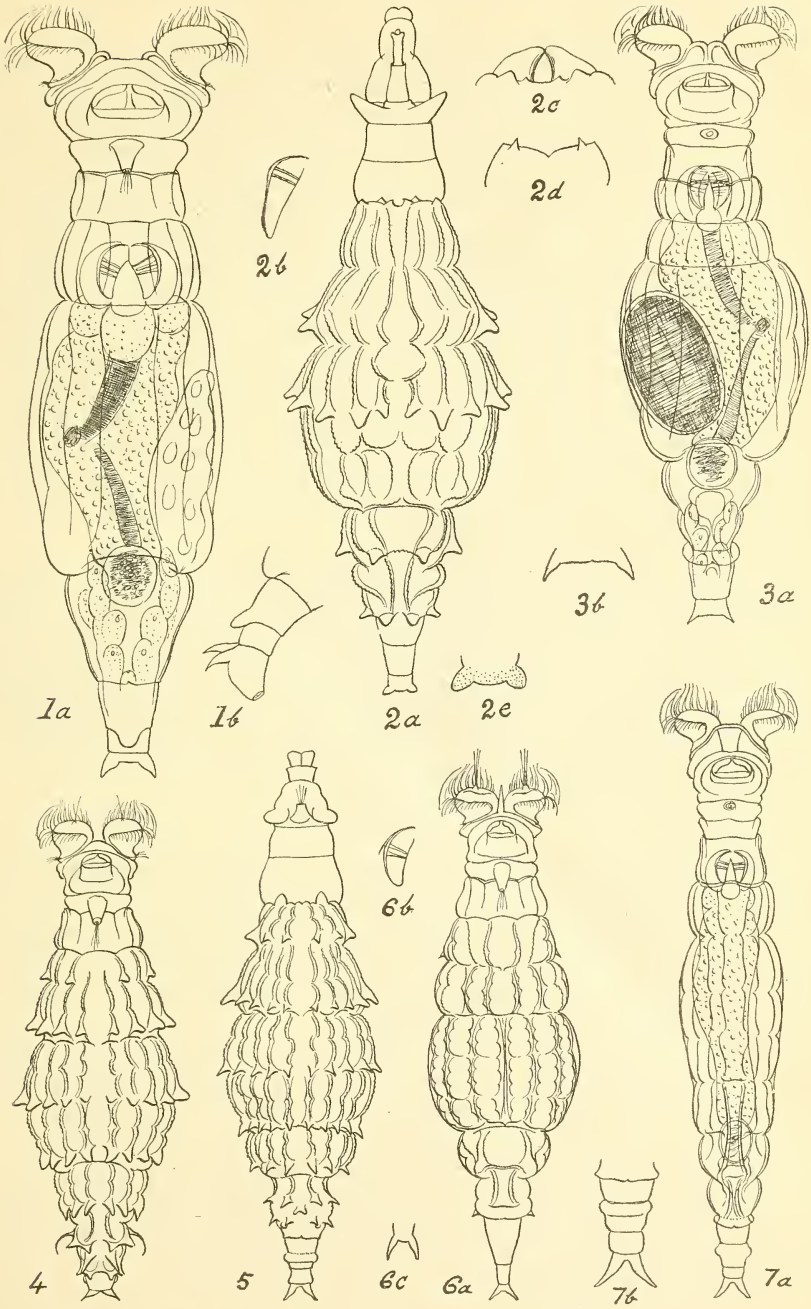
LIST OF SPECIES COLLECTED.

	TRANSVAAL.		CAPE COLONY.	
	Pretoria.	Woodbush.	Knysna.	Pondoland.
Philodina brevipes Murray			×	
P. flaviceps Bryce			×	
P. rugosa Bryce	×		×	
P. vorax (Janson)		×		
P. plena (Bryce)	×		×	
Pleuretra alpium (Ehr.)			×	
P. humerosa (Murray)			×	
P. africana, sp. n.	×			
Callidina habita Bryce	×			
C. formosa Murray				×
C. bullata, sp. n.				×
C. quadricornifera (Milne)				×
C. musculosa (Milne)			×	
C. gunningi, sp. n.	×			
C. hewitti, sp. n.	×			
C. plicata Bryce		×		
C. plicatula, sp. n.	×			
C. aculeata (Milne)	×		×	
C. multispinosa (Thomp.)	×	×		×
C. pinnigera Murray	×	×		×
Mniobia tetraodon (Ehr.)		×		
M. scabrosa Murray			×	
Rotifer vulgaris Schrank			×	
R. longirostris (Janson)	×	×		×
Habrotrocha eremita (Bryce)			×	
H. angusticollis (Murray)	×			
H. ampulla Murray	×			
H. longiceps (Murray)	×			×
H. perforata (Murray)	×	×		×
H. caudata Murray	×			
H. acornis Murray	×			
H. auriculata Murray		×		
H. constricta (Duj.)			×	
H. pulchra (Murray)		×		
H. aspera (Bryce)		×		
H. cucullata, sp. n.	×			
Adineta vaga (Davis)		×		
A. gracilis Janson	×			
A. longicornis Murray	×			
A. barbata Janson		×		

NOTES ON THE SPECIES.

Philodina brevipes Murray.—Two varieties occurred in Cape Colony—*first*, yellow, the trunk stippled, the spurs relatively smaller than in the type; *second*, trunk viscous, sordid with adherent matter, like that figured in "The Bdelloid Rotifera of the Forth Area" (**22**).

PLATE I.



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Pleuretra alpium (Ehr.)—The type did not occur, but the small dull-coloured form which was noted in tropical Africa (**27**), and is known also in Australia and Hawaii.

Pleuretra africana, sp. n. (Plate I, figs. 2*a*–2*e*).—*Specific characters*: Large, brown; neck with two very large conical processes, on either side of the antenna; some minute spines on the anterior margin of the trunk; a dorsal series of ten warts crossing the central segments near the widest part; in front of these two lateral warts at each side; four spines on each of the two segments of what appears to be the rump; foot four-jointed; spurs very short and obtuse, separated by a wide interspace. Teeth two.

General description.—Length about 400μ. The antenna is long and stout. The conical processes on the neck are about 20μ in length. Though not in themselves mobile, they can be brought together as the animal contracts till they touch at the tips. The anterior margin of the trunk bears only a few tooth-like processes. The large furca which admits the antenna in most forms of *P. brycei* is reduced to very small dimensions, and would not hold the antenna. The ventro-lateral spines on the anterior margin are absent. The main dorsal row of ten knobs is as in nearly all forms of *P. brycei*, and the two lateral warts in front of the main row are common to many forms of that species.

The central trunk is nearly quadrate. Following it come two segments which appear to form the rump, but there is some reason to think that the first of these is really homologous with the fourth central of most Bdelloids, and that the second, which appears to be the anal, really consists of the anal and preanal, very much shortened. Each of the apparent segments of the rump bears four warts. The foot is relatively slender, the first joint long and bearing a small transverse dorsal ridge; the second joint very short; the spurs small.

The skin is stippled and wrinkled like that of *P. brycei*; even the spurs are dotted.

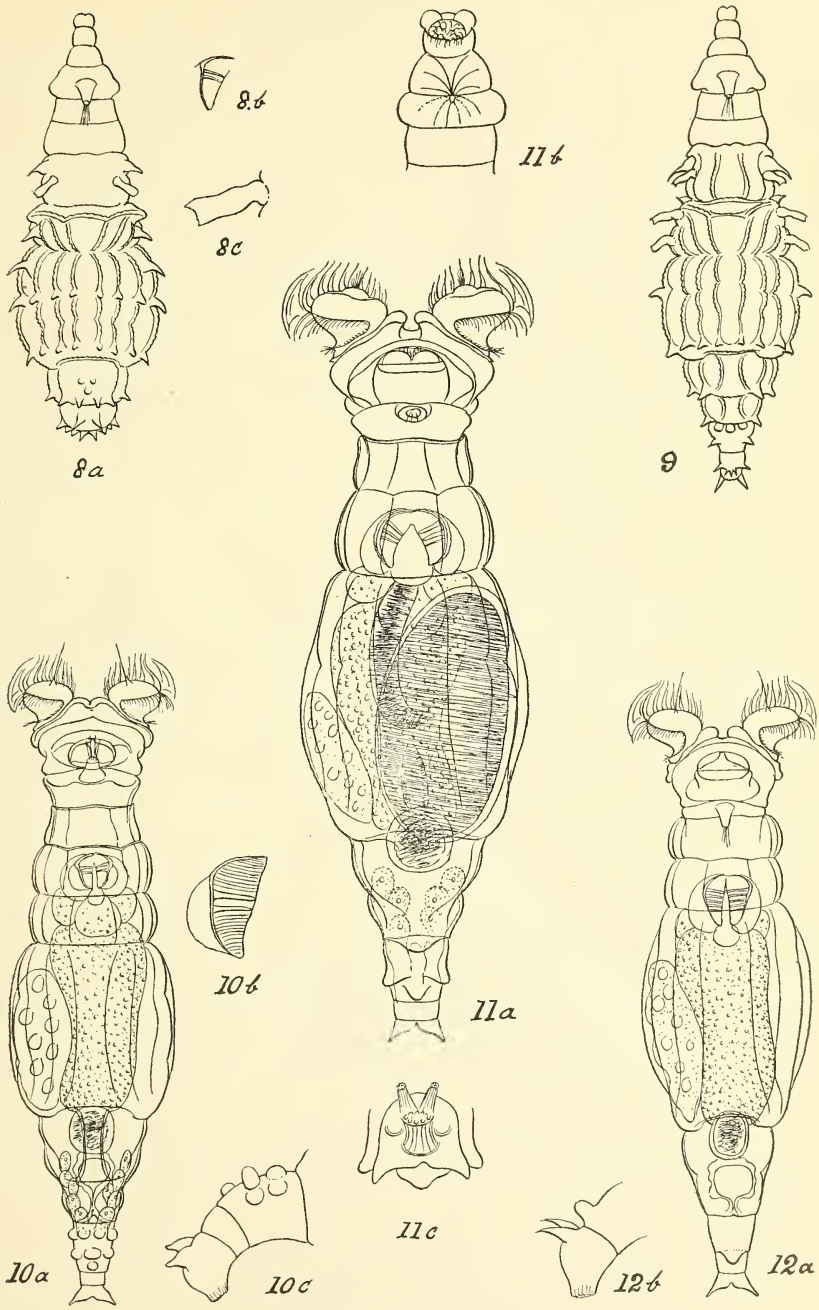
There is a very extensive series of forms, more or less closely resembling *P. brycei* Weber (**38**), and they are so linked together that it is very doubtful if any of them can be separated as distinct species, though each form appears to be fairly constant in the locality where it occurs. I believe they are genuine races, which may be regarded as species or not, according to the conception of species entertained.

Among all these forms which are known to me there is none which offers so many peculiarities as this one which I name *P. africana*, and I have judged it more useful to regard it as a distinct species than as a variety.

Whilst it is on the whole the best armed with spines of all the group, this is combined with the reduction or absence of some of the usual spines. Most of the forms have small rounded processes on the neck; in this they are developed into great thick cones, which give the animal a very unusual appearance in some positions.

The processes on the anterior margin of the trunk are greatly reduced, especially those nearest the dorsal middle line, which usually form a large furca for the antenna, and are themselves often furcate. There are none

PLATE II.



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on the ventral side of the anterior border, where there are usually at each side two characteristic spines, one of which points forward and the other backward.

The main row and the lateral spines on the central trunk are the only processes which are quite normal. All the forms known to me have ten spines in the main row, but Lord (**17**) says there are only eight in *C. cataracta*, and Weber figures only seven.

There is commonly one row, and sometimes two rows, of spines on the central trunk after the main row. This species has none of those. On the apparent preanal segment there are four warts, the dorsal pair of which correspond to those which are usually the last on the body.

The anal segment has also four knobs, which do not occur on any other known form.

The spurs differ from all the other forms. In most they are small and slender, with or without an interspace (Weber figures the type without) and are held almost parallel. *P. africana* has them very short and rounded, divergent, and with a wide interspace.

The characters of the spurs, and the great cones on the neck, were the features which chiefly decided me to separate *P. africana* from *P. brycei*.

Habitat.—Pretoria, collected by J. Hewitt; numerous.

Callidina habita Bryce (**4**).—Two varieties were noted, besides the type.

First (Plate I, figs. 1*a*–1*b*).—Large, differing from the type in three particulars—the corona is broader, and the lobes of the upper lip are widely separated by a straight interspace; the boss of the foot is quite at the end of the first segment of the foot, instead of a little way above the end; the spurs are separated by a broad straight interspace.

Second (Plate I, figs. 3*a*–3*b*).—smaller, head and upper lip as in the type, lobes meeting in median line; anal segment expanded at its end into a sort of thin flange; spurs very small, very widely separated by a straight interspace, with a minute nick in the median line. The foot appears to be only three-jointed. One example of this variety contained an elliptical thick-shelled egg, without the poles produced. It often swims free and rotates on its long axis. There is no foot-boss.

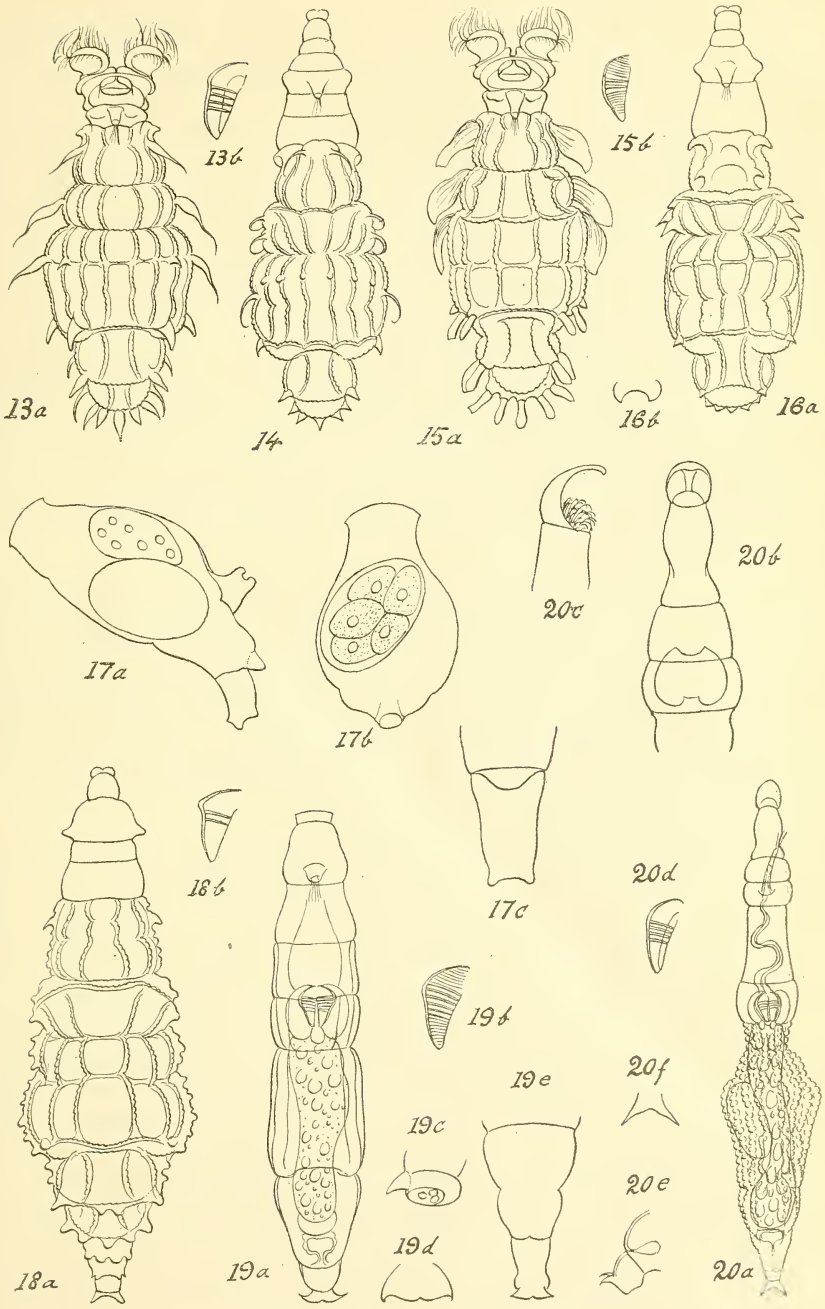
Very probably both of these are distinct species, but they are obviously very close to habita, and are united with it pending further study. *C. habita* is not a very variable species, but it is known to vary in the direction of having the lobes of the upper lip separated, the spurs separated, and the foot-boss obsolete.

C. formosa Murray (**24**).—This agreed with the form in tropical Africa in having the foot and anal segment smooth, and the papillae on the preanal very small.

Callidina bullata, sp. n.; synonym, *Callidina habita* Bryce, var. *bullata* Murray (**23**) (Plate II, figs. 10*a*–10*c*).

Specific characters.—Size moderate; hyaline, except alimentary canal; stoutish, trunk broader than corona. Collar prominent, corona wider than collar, discs with central papillae and setae; lobes of upper lip rounded, meeting in middle line. Antenna short. Teeth, two in each

PLATE III.



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jaw. Foot four-jointed, first joint ornamented with a number of hemispherical knobs, in several series. Spurs broad, divergent, acuminate, meeting in middle line or slightly separated.

General description.—Length about 380μ when feeding; diameter of corona 80μ, collar 75μ, neck μ, trunk 100μ, tip to tip of spurs 30μ. The general form is exactly like habita. The rostrum is broad, with large lamellae. There are prominences on the neck, on each side of the antenna. The jaws are triangular, and slightly constricted below the widest part. The ornamented foot is the only important distinction from habita. The disposition of the knobs is best understood from the figure. The first series contains four equal hemispherical knobs; the second series two similar knobs and a transversely oblong one in the middle line; behind that a single median hemispherical knob. No doubt the knobs may vary somewhat, but no variation has been noticed.

Intermediate between *C. habita* and *C. formosa*. It resembles habita, with the foot ornamented as in the type of formosa. *C. gunningi*, described below, has a superficial resemblance to *C. bullata* in possessing also an ornamented foot, but the knobs are different, only three in number on the foot, and there is another knob, on the anal segment.

Habitat.—Pondoland; abundant. Previously only recorded for Loch Treig in Scotland.

Callidina gunningi, sp. n. (Plate II, figs. 11*a*–11*c*).—*Specific characters*: Large, stout; corona large, with wide interspace; lobes of upper lip not meeting in middle line; rostrum broad; antenna short; teeth $2+1/1+2$; foot of four segments, the first bearing three bosses, two lateral and one dorsal; anal segment with dorsal boss; spurs broad at base, divergent, acuminate, without interspace.

General description.—Length, when feeding, 450μ, diameter of corona 120μ, of cheeks 100μ, of neck 75μ, of trunk 140μ, of first foot-joint 40μ, across spurs 35μ, length of jaw 35μ.

The discs are large, measuring between 45μ and 50μ, and they are separated by an interspace of almost 30μ; the central setae, or pencils of setae, are very short, and spring from very broad low processes. The collar is very inconspicuous, but the skinfolds running from it to form part of the upper lip increase in thickness towards the lip, and end in two prominent lobes, which are separated by a very deep sulcus, through which can be seen the "bridge" joining the two pedicels. The cheeks are bulging, and are separated by a constriction from smaller prominences just over the neck. The jaws are almost semicircles in outline, and have thickened borders. The principal teeth are thick, and the smaller striae are conspicuous.

The central trunk is barrel-shaped, and is longitudinally plicate with few broad folds. The rump is sharply marked off from the central trunk, and its two segments, though short, are clearly separable. The anal segment has a large dorsal boss or projection, on its posterior margin, just at the anus. The three processes on the first foot-joint are very prominent. The second foot-joint is short, and has no processes.

The stomach is voluminous, and its walls are filled with large globules or granules. The lower portion of the canal, next the intestine, is distinctly

ciliate. The intestine is round. The glands between the mastax and the stomach are large.

A large, elliptical, thick shelled egg has been seen in the body. It measured 150μ by 90μ.

C. gunningi is one of a group of species of which *C. habita* Bryce may be taken as the type. It is only necessary to compare it critically with two species, *C. formosa* and *C. bullata*, which also have bosses on the first foot-joint. *C. formosa* (**24**) is easily distinguished, as the whole trunk is papillose. *C. bullata* Murray was described as a mere variety of *C. habita* (**23**), and is in this paper for the first time treated as a distinct species. It has a strong superficial resemblance to *C. gunningi*, yet differs in many characters. It is smaller, and has a prominent collar; the lobes of the upper lip meet in the middle line; there is no boss on the anal segment, and there are eight bosses on the first foot-segment. Attention to these points will make it easy to distinguish the two species. The armature of the foot of *C. gunningi* was constant in character in a large series of examples.

Habitat.—Pretoria, in moss collected by J. Hewitt; very abundant.

Callidina hewitti sp. n. (Plate II, figs. 12*a*–12*b*).—*Specific characters*: Of moderate size, hyaline; corona large, collar prominent, lobes of upper lip separated by small interspace; rostrum broad, antenna short; teeth about five in each jaw; first segment of foot with a large boss; spurs broad-based, acuminate, divergent, without interspace.

General description.—Length, when feeding, 360μ, diameter of corona 96μ, collar 70μ, neck 50μ, trunk 104μ, across spurs 30μ, length of jaw 30μ. The discs are about 35μ in diameter and bear long central seta, which arise from small papillae; the interspace between the discs is about 22μ. The skinfolds forming the collar are prominent, and are continued on to the upper lip where they end in large rounded lobes, separated by a small deep sulcus. Each jaw is triangular, and bears four or five strong teeth, with one thinner and numerous fine striae.

The trunk is barrel-shaped, with few, wide, longitudinal plicae. The rump is pyriform, with its two segments scarcely separated. The foot is four-jointed, the first joint bearing a boss like that of *C. habita*, but on the extreme posterior edge of the segment. The spurs are like those of *C. habita*. There is nothing peculiar in the internal organization. The stomach is voluminous, and the intestine shortly oval.

C. hewitti is another species related to *C. habita*. The numerous teeth distinguish it from all the species of that group, except *C. vesicularis* Murray (**21**), which is easily known by the two knobs on the first segment of the foot, and by the large vibratile tags. *C. hewitti* differs from *C. habita* in some minor characters—the separation of the lobes of the upper lip, and the more posterior position of the foot-boss.

Habitat.—Pretoria, among moss collected by J. Hewitt, April, 1910; several examples, but not abundant.

Callidina plicatula, sp. n. (Plate I, figs. 7*a*–7*b*).—*Specific characters*: Size moderate; slender; corona fairly large, discs separated by flat interspace; upper lip rounder, having a keystone-shaped central portion; collar prominent; antenna short; teeth 2–2; trunk deeply plicate;

rump with two deep constrictions; foot four-jointed, the second segment wider than the first, and having a kind of projecting annulus; spurs somewhat long, tapering, without interspace, outcurved; toes three.

General Description.—Length when feeding, about 370μ, diameter of corona 65μ, of neck 40μ, of trunk 70μ, tip to tip of spurs 25μ, length of spur 12μ to 15μ. The discs are large, and the space separating them is about equal to half the diameter of a disc. The upper lip is unlobed and rounded, but somewhat flattened in the middle. Two lines run from its boundary, converging towards the rostrum, enclosing a space shaped like the keystone of an arch. There are central setae on the discs. The rostrum is broad, with the lamellae apparently separated, and the antenna is very short.

The skinfolds of the trunk are deep, and there are two especially pronounced ones running from the central trunk on to the preanal, near the median line, a similar pair continuing on to the anal. The anal and preanal segments are swollen, and separated by a deep constriction. The anal expands at its extreme end into a narrow flange.

The first segment of the foot is very short. The second is about as long as broad, and is broader than the first segment, bearing an annular thickening near its anterior edge. The spurs are like those of *C. plicata* Bryce (**3**), but they are relatively somewhat shorter. There is nothing calling for remark in the internal organization.

As the name is intended to imply, this species is very closely related to *C. plicata*. It differs in the entire upper lip, the total absence of the flanges on the rump, and in the enlarged second foot-segment. The close resemblance to *C. plicata* appears in the keystone form of the central part of the upper lip, the folds of the posterior part of the trunk, the deep constrictions bounding the anal and preanal segments, and the form of the spurs. Only *C. plicata* and two related species have those lines on the upper lip which give the appearance of a keystone. Some forms of *C. plicata* completely lack the flanges or processes on the rump. The characters of lip and foot sufficiently distinguish *C. plicatula* from such forms of *C. plicata*.

Like *C. plicata* it is extremely restless and jerky in its movements, and is thus very difficult to observe accurately.

Habitat.—Pretoria, in moss collected by J. Hewitt, April, 1910; plentiful.

Callidina aculeata (Milne) (**19**); synonym, *Macrotrachela aculeata* Milne (Plate I, figs. 4–6*c*).—Three distinct forms were observed. As Mr. Milne's figure is too small to show much detail, and his description is somewhat meagre, I will here figure and describe all three as fully as possible.

First (Fig 5).—Sufficiently near Milne's type, it has two dorsal series of spicules on the anterior trunk, two on the central trunk (one of them at the widest part), and three on the "rump". The anterior margin of the trunk shows two prominences on the dorsal side, and four smaller points on the ventral side. The two anterior rows of spicules are continued across the ventral side also; all the other rows are interrupted on the ventral side. The ventral surface of the central trunk is transversely plicate, and the folds are scalloped. There are some small spicules on

the verge of the ventral surface besides those belonging to the series. The anal segment is curiously swollen, and separated by a constriction from the segment in front. It is a question whether the segment in front of the apparent anal segment is the preanal or the fourth central. If the latter, the seeming anal must be compounded of two segments. The first foot-joint has an annular swelling near its posterior extremity. The foot is four-jointed. The spurs are somewhat slender, divergent, acuminate, without interspace. Teeth two; antenna $\frac{3}{5}$ of neck width; length, creeping, 225μ.

Second (Fig. 4).—The series of spines on the trunk are as in the first variety, but they are larger and obtuse. The anterior row has fewer spines. There are no prominences on the anterior margin of the trunk. The spines of the rump differ from those of the preceding variety—especially there are two longish curved lateral spines, which have not been noted for any other variety of the species. Collar very prominent; discs separated by a narrow, deep sulcus; central papillae and setae on discs; length of antenna equal to $\frac{1}{2}$ to $\frac{3}{5}$ of diameter of neck. Teeth two. Only the second series of spines continues right across the ventral side. Length, 300μ.

Third (figs. 6*a*–6*c*).—Distinguished from the two preceding varieties by the reduction in the number of spines. There are no transverse rows, and there are only two lateral spicules belonging to the anterior row, and two lateral spicules on the anal segment. The longitudinal skinfolds are very prettily scalloped. The foot is slender, and without annular swelling. The spurs are slender, incurved, and are separated by a small interspace. The collar is very prominent, and the narrow sulcus between the discs is quite filled by a large "ligule". Teeth two.

These extreme forms indicate a wide degree of variability, but the whole group to which they belong is excessively variable. Till recently I did not suppose *C. aculeata* to be closely related to what has been called the multispinosa group. The second variety described above has the slender lateral spines on the rump which are eminently characteristic of that group.

The multispinosa group is a vast congeries of forms, some half-dozen of which have been recognized as species, but including a multitude of widely diverse forms, which are so linked together that it is often impossible to decide to which of several species they should be assigned. I believe the group to constitute a genus distinct from Callidina, although it could only be distinguished by superficial characters. Such characters have already been used to separate genera of Bdelloids—for example, *Pleuretra* Bryce (**5**).

Callidina multispinosa Thomp. (**35**); synonym, *Macrotrachela multispinosa* Thomp. (Plate I, figs. 8–9, and Plate III, figs. 13 14 16–18).—Besides approximately typical longspined forms, there occurred five distinct varieties.

First (fig. 13).—A long-spined variety, differing from the type chiefly in that the spines are swollen below, and setiform above. A very similar variety is known in India, and is figured (**24**). The African form, while superficially very similar, differs in many little points, in the aggregate

of some importance. There are fewer long spines on the two anterior trunk segments—the lateral spicule between the first and second segments of the anterior trunk are lacking. The two transverse dorsal series of spines are lacking, only the two end members of each being present. The lateral process at the widest part of the trunk is a long swollen spine, the second is a spicule. The two processes at the posterior corners of the trunk are thick curved horns (as in variety *crassispinosa* Murray [**25**]). The processes on the rump are large and lanceolate, whereas in the Indian form they are small " combs " of several spicules each. There is a slender lateral spine on the anal, not present in the Indian form. Teeth, four in each jaw; central setae on discs.

Second.—Variety *brevispinosa* Murray (**26**). Exactly as described from Old Calabar, 1908. Mr. Bryce at the first expressed the belief that this was specifically distinct from multispinosa. Further experience of many forms gives weight to his opinion. It is found that the short-spined forms have almost invariably only two teeth while the long-spined forms have from three to five teeth. I have seen only two individual exceptions (a short-spined one with four teeth, and a long-spined with only two) which either prove the rule or upset it. As the whole group needs overhauling, brevispinosa is left in the meanwhile a variety.

Third.—Short-spined. Distinguished by the extreme reduction of the spines. There are only a few lateral spicules on the anterior trunk, none on the central except small spicules on the posterior corners, and a few small ones on the rump. The spurs are very short, blunt, and incurved, as shown in the figure (fig. 16).

Fourth (figs. 8*a*-8*c*.)—Short-spined; differing from brevispinosa chiefly in the replacing of some of the spines of the anterior trunk by somewhat ligular processes, having small bulbose bases and expanded flat tips. Teeth, two.

The development of ligular processes is carried further in a form from Central Africa, which is here figured for comparison, as it has never before been figured (fig. 9). It will be seen that this form has three pairs of ligular processes on the anterior trunk. The lateral process on the first trunk segment is a sharp curved spine with a bulbose base. Teeth, two.

Fifth (fig. 14).—A puzzling form, resembling multispinosa, brevispinosa, and pinniger. On the first trunk segment there is only one pair of slender curved spines; on the second segment there are two pairs of lateral broad leaf-like laminae; on the central trunk there is a transverse row of little knobs, and near the ends of the row, on each side, a lateral curved spine.

Sixth (fig. 18).—A variety resembling brevispinosa, but with knobs instead of spines, thus approaching, or at least resembling *C. papillosa*. The knobs are so numerous that the outline has an erose appearance.

Callidina pinnigera Murray (**26**) (Plate III, fig. 15).—This species varies extremely, being closely linked with *C. multispinosa* and *C. zickendrahti* Richters (**28**). These extreme forms do not occur in Africa. The form from Pondoland only differs from the type in minor details. The broad fins are not so broadly truncate, and are not widest at the end, but some way lower down. The processes at the angles of the fourth central,

preanal, and anal segments are ligular and expanded upwards; in the type they are stout spines with bulbose bases. The five processes forming a transverse row on the anal are also ligular, and they are widely divergent and separated; in the type they are very broad, leaf-like, imbricated.

Mniobia scabrosa Murray (**27**).—Discovered in Uganda (Pearce) 1907, but only recently described; it is now known also in New Zealand and Australia.

Rotifer longirostris (Janson) (**15**); synonym, *Callidina longirostris* Janson.—Rousselet's record of *R. tardus* for Natal, doubtless based on Kirkman's note, probably refers to this species, which is very common in Africa. The variety (or perhaps only "state") *fimbriata* Murray (**24**) is commoner than the type.

Habrotrocha angusticollis Murray (**20**).—Besides the usual brown cases, hyaline cases were noted.

H. ampulla Murray (**27**).—First found by Pearce (1907), but only recently described; it is now known also in Australia.

H. eremita (Bryce) (**4**).—Apparently a rare species, but commoner in Africa than elsewhere.

H. perforata (Murray) (**24**).—Though a common species in tropical and sub-tropical countries, the foot had never been seen. This was owing to the difficulty of getting the animal out of its shell. In Cape Colony dead examples were found without shells, and several new features were discovered. There is a small dorsal "tail", like that of *H. caudata*, which occupies the posterior tube of the shell. Beside the anus there is another process, blunt and conical. The foot is very short, but apparently of two joints between the anus and the spurs. The spurs are very short and obtuse, and are separated by a wide interspace (Plate III, figs. 17*a*–17*c*).

H. caudata Murray (**27**).—Only recently described from tropical Africa, the species is now known also in Australia.

H. acornis Murray (**27**).—Recently discovered in British East Africa; not yet known except in Africa.

H. auriculata Murray (**27**).—Recently discovered in British East Africa, and now known in Australia.

Habrotrocha cucullata, sp. n. (Plate III, figs. 20*a*–20*d*).—*Specific characters*: Small, slender; trunk papillose; rostrum constricted between the two joints, lamella forming a single spoonshaped hood; corona small; antenna slender, length equal to the diameter of the neck; teeth about four in each jaw; foot very short; spurs narrow, tapering, divergent, without interspace.

General description.—Extreme length when extended 300μ. The trunk is of a pale yellow colour, and is closely plicate and papillose. The neck and foot are smooth and colourless. The body is of characteristic form, having pronounced constrictions which habitually return after all the changes of form. One such constriction is at the base of the terminal joint of the rostrum; another is in the anterior part of the trunk. The widest part of the central trunk varies in position with the movements

of the animal. The rump is small, and the foot extremely small, with little trace of segmentation. The spurs are of moderate size, acuminate, and widely divergent.

The gullet is very long and makes several loops between the mouth and the mastax. The jaws are narrow, triangular, and bear usually four teeth in each. The stomach is voluminous and filled with pellets.

The corona was never seen unfolded, but in the contracted state it can be seen to be of the type which prevails in the genus, in which the discs are scarcely separated. The two segments of the rostrum are unusually distinct, the end one being enlarged like the end joint of the thumb (as in *Pleuretra humerosa*) (**20**). The two lamellae are never apparent. They appear to have coalesced completely into a single large hood, like that of Colurus or Metopidia, which arches over the brush of cilia.

It is rarely advisable to describe a Bdelloid rotifer as a new species if it has not been seen with the corona expanded, feeding. Even if it is undeniably a distinct species, it must have very pronounced features before it can be safely described, and the description must be careful and as complete as possible.

In this case the concurrence of a papillose trunk with a definite general form, and especially the peculiar form of the rostrum and lamellae, seem to justify the course taken, as the animal should be recognizable with confidence from these characters. There are only a few species of Habrotrocha which have the trunk papillose, and there are none known in which the lamellae form such a definite single hood. A hood most nearly approaching that of *H. cucullata* is found in *Callidina natans* (**23**). Two species of the genus are papillose, *H. aspera* and *H. crenata*. *H. aspera* has only two teeth in each jaw; *H. crenata* has a greater number of teeth than *H. cucullata*, a shorter antenna, and there are prominent lateral bosses on the rump.

Habitat.—Pretoria, collected by J. Hewitt, April, 1910; fairly numerous.

Habrotrocha sp. (Plate III, figs. 19*a*–19*e*).—A small animal, with spurs of distinctive form, like those of *C. quadricornifera*. It is certainly a good species, but has not been sufficiently studied. The rostrum is very short and broad. The jaw is triangular, with five or six teeth. The foot is very short, and the penultimate segment (which bears the spurs) has an annular swelling like that of *Philodina indica*.

Habitat.—Woodbush; also known in British East Africa.

Summary of Results.

Our list numbers forty species, of which six are described as new species, thirty-one others are new records for South Africa, and sixteen are new records for Africa. One of the new species (*Callidina bullata*) had been previously described as a variety of *C. habita*.

It seems remarkable, as a first glance, that only three of our forty species should be found in Mr. Rousselet's list. The explanation is that all our species were obtained from dry moss, whilst all those in Rousselet's list are aquatic species. The presence of three aquatic species in our list

is rather surprising, but they may have come from eggs. Although I know that Mr. Milne has worked at the Bdelloida of mosses, he has not included any of the moss dwellers in the list which he supplied to Mr. Rousselet.

Although forty species is a considerable number to obtain from dry mosses, our mosses yielded more than that. Several species were observed which have not yet been described, but they were previously known to other naturalists. Some other distinct species were found, but they were not sufficiently studied.

RÉSUMÉ OF ALL AFRICAN BDELLOIDS.

Historical sketch.—In this account of the history of the knowledge of African Bdelloids only the continent is considered—the islands are left out of the account, except when the general distribution is in question.

The first mention of African Bdelloids I find in Ehrenberg, who in 1832 (**10**) records three species for North Africa, and in a later paper of the same year these species are described (**11**). They are *Hydrias*, *Typhlina*, and *Rot. vulgaris*. In the Mikrogeologie 1854 (**12**) he adds the three species *Callidina rediviva*, *C. tetraodon*, and *C. hexaodon*, possibly recorded in earlier papers which I have not traced. In the same year Schmarda (**32**) notes four species in Egypt, and in 1859 (**33**) he mentions the same four.

For more than thirty years I find no further note of African Bdelloids, when in 1891 Stuhlmann records a Rotifer sp. for the Victoria Nyansa (**34**). In Barrois and Daday's ten Rotifera from Egypt 1894 (**2**) there does not appear to have been any Bdelloid, according to Daday 1910 (**9**). In 1896 Collin found three species, including the new species *Phil. emini*, in Stuhlmann's material from East Africa (**6**). In 1898 Marchoux (**18**) described *Phil. parasitica* from Senegal. In 1907 Daday (**7**) mentions two species from the Victoria Nyanza, and in 1910 (**8**) he records *Ct nurus* for the Soudan, and later in 1910 (**9**) seven species for German East Africa.

There remain only my two papers—1908 (**23**), nine species (one new) from Old Calabar and Uganda; 1911 (**27**), thirty-three species (nine new) from British East Africa. The papers on South African species were noted in the Introduction.

From these various works I have compiled the accompanying list of all known African Bdelloids. The list includes the doubtful species recorded by Ehrenberg and Schmarda. It is now questioned whether some of Ehrenberg's species were even Bdelloids at all. These doubtful species, which we still cannot authoritatively disallow, are indicated by an asterisk.

The distribution in Africa is indicated in twelve columns, but the world-distribution in detail is not attempted, though some notes on the subject are added.

In 1907 the British Antarctic Expedition collected eleven species of Bdelloids on Table Mountain, which have not yet been recorded. As the paper dealing with them goes to press about the same time as this, and as it is quite uncertain which will appear first, they are included in this list. Among them is the new species *Dissotrocha pectinata*.

DISTRIBUTION OF ALL AFRICAN BDELLOIDS.

	NORTH.		CENTRAL.					SOUTH.					
	Egypt.	Sahara.	Senegal.	Calabar.	Brit. E. Africa.	Ger. E. Africa.	Congo.	Mozambique.	Rhodesia.	Transvaal.	Natal.	Cape Colony.
Philodina citrina Ehr.						×						×
P. flaviceps Bryce												×
P. roseola Ehr.	×					×					×	
P. brevipes Murray												×
P. erythrophthalma Ehr.											×	
P. megalotrocha Ehr.											×	×
**P. gracilis* Schmarda	×											
**P. calcarata* Schmarda	×											
**P. parasitica* Marchoux			×									
P. rugosa Bryce					×					×		×
**P. emini* Collin						×						
P. plena (Bryce)					×					×		×
P. vorax (Janson)					×					×		×
Pleuretra alpium (Ehr.)					×							×
P. humerosa (Murray)					×							×
P. brycei (Weber)					×							
P. africana Murray										×		
Dissotrocha aculeata (Ehr.)						×						×
D. macrostyla (Ehr.)												×
D. pectinata Murray												×
**Callidina elegans* Ehr.												×
C. habita Bryce					×					×		×
C. formosa Murray					×							×
C. bullata Murray												×
C. quadricornifera (Milne)												×
C. musculosa (Milne)												×
C. gunningi Murray										×		
C. hewitti Murray										×		
C. allani Murray					×							
C. plicata Bryce					×					×		×
C. plicatula Murray										×		
C. punctata Murray					×							
C. papillosa (Thomp.)					×							
C. aculeata (Milne)					×					×		×
C. multispinosa (Thomp.)				×	×					×		×
C. pinnigera Murray					×					×		×

	NORTH.		CENTRAL.					SOUTH				
	Egypt.	Sahara.	Senegal.	Calabar.	Brit. E. Afri a.	Ger. E. Africa.	Congo.	Mozambique.	Rhode-ia.	Transvaal.	Natal.	Cape Colony.
**C. rediviva* Ehr.		×						×				×
**C. hexaodon* Ehr.												×
Mniobia tetraodon (Ehr.)		×			×					×		
M. russeola (Zel.)					×							
M. scarlatina (Ehr.)					×							
M. scabrosa Murray					×							×
Rotifer vulgaris Schrank	×					×					×	×
R. macrourus Müller						×					×	
R. macroceros Gosse						×						×
**R. megaceros* Schmarda	×											
R. tardigradus Ehr.												×
R. longirostris (Janson)					×					×	×	×
R. neptunius (Ehr.)						×	×		×		×	×
Habrotrocha eremita (Bryce)					×							×
H. angusticollis (Murray)				×						×		×
H. ampulla Murray					×					×		
H. longiceps (Murray)				×	×					×		×
H. pusilla (Bryce)					×							
H. perforata (Murray)				×	×					×		
H. caudata Murray					×					×		×
H. acornis Murray					×					×		
H. constricta (Duj.)					×					×		×
H. crenata (Murray)					×							
H. appendiculata Murray					×							
H. pulchra (Murray)								•		×		
H. aspera (Bryce)										×		
H. cucullata Murray										×		
H. brocklehursti Murray					×							
H. auriculata Murray					×							
Adineta vaga (Davis)					×					×		×
A. gracilis Janson										×		×
A. longicornis Murray					×					×		×
A. barbata Janson					×					×		×
**Hydrias cornigera* Ehr.	×											
**Typhlina viridis* Ehr.	×											

In this table I have included all the records known to me, whatever my opinion of their value, unless in any instance it could be shown that two recorded names were synonyms. The species of doubtful identity are indicated by an asterisk (*).

The list contains 71 species, a very considerable number, when we consider that Bryce as recently as November, 1910 (**5**), admitted only 105 species of Bdelloids for the whole world. However, some 15 new African species have been described since that date.

If we deduct the doubtful species, which may of course possibly be repeated in the list, there are sixty-one well authenticated African species. These are distributed in the different localities as follows :—Egypt seven species, Sahara two, Senegal one, Calabar four, British East Africa thirty-five, German East Africa eight, Congo Free State one, Mozambique one, Rhodesia one, Transvaal twenty-eight, Natal seven, and Cape Colony thirty-nine.

Eighteen species, about quarter of the total, are only known in Africa ; five of them are confined to North Africa (Egypt), one to West Africa (Senegal), four to East Africa, and six to South Africa. Thirty species are common to Central and South Africa, but only two of these are among the species peculiar to Africa. Of course with advancing knowledge these limitations are not likely to remain long.

There are only three of the districts about the moss-faunas of which we know much, and they all have very fair lists of species—British East Africa thirty-five, Transvaal twenty-eight, Cape Colony thirty-eight. The moss-dwellers, in fact, form the great bulk of the Bdelloida—at least fifty of them are in our African list.

In the islands adjacent to the African continent a few species have been recorded—for the Azores, by Barrois, 1888 (**1**) ; the Canaries, by Heinis, 1908 (**13**) ; Madagascar, by Voeltzkow, 1891 (**37**), and Murray, 1908 (**26**) ; the Comoro Islands by Richters, 1908 (**29**). Among these there are only two species which are not known on the continent, *Mniobia symbiotica* in the Canaries, and *Habrotrocha crenata*, variety *nodosa* (now regarded as a distinct species), in Madagascar.

The general distribution of the African Bdelloids over the world is not indicated. The published facts are scarcely sufficient to make this of any value. It may be said in a general way that about forty of the African species are common, and fairly widely distributed, though only a few can be described as cosmopolitan.

The other thirty seem to be rare or local, as far as our present knowledge goes—eighteen of them, as already stated, being only known in Africa.

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EXPLANATION OF PLATE I.

Fig. 1*a*. *Callidina habita* Bryce; variety with lobes of upper lip separated.
1*b*. The same; side view of foot.
2*a*. *Pleuretra africana* Murr.
2*b*. The same; jaw.
2*c*. The same; the neck lobes approximated.
2*d*. The same; anterior ventral margin of trunk.
2*e*. The same; spurs.
3*a*. *C. habita*; variety having anal segment expanded at the posterior end.
3*b*. The same; spurs.
4. *C. aculeata* Milne; form with many blunt knobs, and lateral setae on the rump.
5. The same; form with many spicules, and no lateral setae.
6*a*. The same; form with few spicules; ligule between discs.
6*b*. The same; jaw.
6*c*. The same; spurs.

Fig. 7*a*. *C. plicatula* Murr.
7*b*. The same; foot.

EXPLANATION OF PLATE II.

Fig. 8*a*. *Callidina multispinosa* Thomp.; variety with some ligular processes.
8*b*. The same; jaw.
8*c*. The same; one ligule.
9. *C. multispinosa*; variety similar to 8, but with more of the ligular processes (from East Africa).
10*a*. *C. bullata* Murray.
10*b*. The same; jaw.
10*c*. The same; side view of foot.
11*a*. *C. gunningi* Murray.
11*b*. The same; head and rostrum, ventral view.
11*c*. The same; foot, showing knobs and toes.
12*a*. *C. hewitti* Murray.
12*b*. The same; side view of foot.

EXPLANATION OF PLATE III.

Fig. 13*a*. *Callidina multispinosa* Thomp.; variety with processes swollen below.
13*b*. The same; jaw.
14. *C. multispinosa*, another variety.
15*a*. *C. pinniger* Murray.
15*b*. The same; jaw.
16*a*. *C. multispinosa*; short-spined variety.
16*b*. The same; spurs.
17*a*. *Habrotrocha perforata* Murray; side view of an animal without its shell, showing the two dorsal processes, and the spurs.
17*b*. The same; shell containing an egg.
17*c*. The same; dorsal view of foot, showing spurs and second dorsal process.
18*a*. *C. multispinosa*; short-spined "erose" variety.
18*b*. The same; jaw.
19*a*. *Habrotrocha*, sp.
19*b*. The same; jaw.
19*c*. The same; side view of penultimate segment, showing annular swelling.
19*d*. The same; spurs.
19*e*. The same; rump and foot.
20*a*. *Habrotrocha cucullata* Murray.
20*b*. The same; head, rostrum, and hood.
20*c*. The same; side view of hood.
20*d*. The same; jaw.
20*e*. The same; side view of foot.
20*f*. The same; spurs.